INNOVATIVE TECHNOLOGY
Summary Report

DOE/EM-0632

Cone Permeameter™

Innovative Subsurface Characterization and Monitoring Technology

Characterization, Monitoring, and Sensor Technology Crosscutting Program and Subsurface Contaminants Focus Area

Prepared for
U.S. Department of Energy
Office of Environmental Management
Office of Science and Technology

September 2002

INNOVATIVE TECHNOLOGY
Summary Report

Cone Permeameter™

Tech ID 307

Characterization, Monitoring, and Sensor Technology Crosscutting Program and Subsurface Contaminants Focus Area

Demonstrated at
Savannah River Site
Aiken, South Carolina

INNOVATIVE TECHNOLOGY
Summary Report

Purpose of this document

Innovative Technology Summary Reports are designed to provide potential users with the information they need to quickly determine whether a technology would apply to a particular environmental management problem. They are also designed for readers who may recommend that a technology be considered by prospective users.

Each report describes a technology, system, or process that has been developed and tested with funding from DOE's Office of Science and Technology (OST). A report presents the full range of problems that a technology, system, or process will address and its advantages to the DOE cleanup in terms of system performance, cost, and cleanup effectiveness. Most reports include comparisons to baseline technologies as well as other competing technologies. Information about commercial availability and technology readiness for implementation is also included. Innovative Technology Summary Reports are intended to provide summary information. References for more detailed information are provided in an appendix.

Efforts have been made to provide key data describing the performance, cost, and regulatory acceptance of the technology. If this information was not available at the time of publication, the omission is noted.

All published Innovative Technology Summary Reports are available on the OST Web site at www.em.doe.gov/ost under "Publications."

TABLE OF CONTENTS

APPENDICES

SECTION 1
SUMMARY

Technology Summary

Problem: Cleanup of hazardous waste left after 50 years of U.S. production of nuclear weapons is the largest environmental management problem in the world. DOE currently has 353 projects at 53 cleanup sites; the program is responsible for characterization and cleanup of approximately 9,000 release sites at these 53 sites. The cleanup of release sites involves the remediation of soil surface water and/or groundwater. In most cases where the contamination has moved into the subsurface, remedial treatment requires removal of groundwater for surface treatment, circulation of groundwater through a treatment cell, or circulation of treatment fluids or gases. In all cases, a detailed knowledge of the permeability distribution in the subsurface is needed to support groundwater modeling efforts and will lead to more efficient design of remedial systems.

How It Works: The Cone Permeameter™ a sensor designed to be deployed using a cone penetrometer. The sensor measures air permeability and saturated hydraulic conductivity of soils at discrete intervals in the subsurface. These measurements allow one to predict how groundwater and air will move through the subsurface. Determining the permeability of sediments is essential for predicting the migration paths of contaminants and for designing optimal remediation strategies.

Figure 1. Bill Lowry and Neva Mason from Science and Engineering Associates in the DOE SCAPS truck operating the Cone Permeameter™ at the Interagency DNAPL Consortium Site at the Cape Canaveral Air Station in Florida.

Potential Markets: The potential market for the Cone Permeameter™ is very large because the technology is an inexpensive system that measures a key parameter needed in groundwater modeling and in support of design and optimization of the remedial systems at large or complex waste sites.

Commercialization Status: The Cone Permeameter™ was developed by Science and Engineering Associates (SEA) under funding from the DOE National Energy Technology Center. Geoprobe Systems, Inc., has licensed the Cone Permeameter™ patent from SEA and will begin manufacturing and distributing the systems through their marketing network beginning in 2001. The system will be available for use by DOE contractors and environmental firms, including SEA, for field application.

Advantages over the Baseline: Costs for characterization of the permeability distribution at a typical site to support groundwater modeling and remedial design efforts should be reduced by 60-75% over baseline hydraulic testing. The use of the Cone Permeameter™ minimizes or eliminates secondary waste from the installation of the monitoring wells and more significantly from groundwater that must be collected and treated during baseline hydraulic testing.

Demonstration Summary

The Cone Permeameter™ has been demonstrated and/or deployed at four waste sites within the federal government complex.

- D-Area Coal Pile, Savannah River Site: The Cone Permeameter™ was used in 1998 to make detailed permeability profiles in the saturated zone. These measurements were comparable to previous estimates of hydraulic conductivity made at this location with a flow meter during a pumping test.
- Old Burial Ground, Savannah River Site: The system was used in June 1998 to characterize the permeability distribution in the landfill cover material at the Old Burial Ground
- Launch Complex 34, Cape Canaveral Air Station: The Cone Permeameter™ was used to make two permeability profiles at the location of the Interagency DNAPL Consortium Site at Cape Canaveral. The system provided a detailed profile of permeability in the saturated sediments that corresponded well with two measurements made in the laboratory with core material.
- 200 East Area, Hanford: The system was used in November of 1998 at the 200 East Area at the Hanford Site. The purpose of the activity was to evaluate the ability of the system to measure air permeability in the vadose zone sediments at Hanford. The measurements were all within half an order of magnitude of measurements on laboratory samples. Specific design modifications were made to improve the performance of the system in unsaturated sediments.

Contacts

Technical
Bill Lowry, Science and Engineering Associates, Inc., 505-424-6955, blowry@seabase.com
Carol Eddy-Dilek, Westinghouse Savannah River Company, 803-725-2418, carol.eddy-dilek@srs.gov
Tom Christy, Geoprobe Systems, Inc., 800-436-7762, christyt@geoprobesystems.com

Management
John Jones, Department of Energy, 702-295-0532, jonesjb@nv.doe.gov
Beth Moore, US DOE, 202-586-6334, beth.moore@em.doe.gov

Other
All published Innovative Technology Summary Reports are available on the OST Web site at www.em.doe.gov/ost under “Publications.” The Technology Management System (TMS), also available through the OST Web site, provides information about OST programs, technologies, and problems. The Tech ID for Cone Permeameter™ is 307.

SECTION 2
TECHNOLOGY DESCRIPTION

Overall Process Definition

The Cone Permeameter™ is a sensor designed to be deployed using a cone penetrometer. The system measures both in-situ air permeability and saturated hydraulic conductivity of soils at discrete intervals in the subsurface. These measurements allow one to predict how groundwater and air will move through the subsurface. Determining the permeability of sediments is essential in predicting the migration of contaminants in order to design optimal remediation strategies.

Deployed using a cone penetrometer truck, the Cone Permeameter™ system includes

- a modified cone penetrometer rod section that can inject water or air into the subsurface and measure the pressure at different locations along the rod section,
- 150 feet of signal and fluid transfer line; and
- a measurement system consisting of a pump module, instrument module, and a data acquisition and analysis computer.

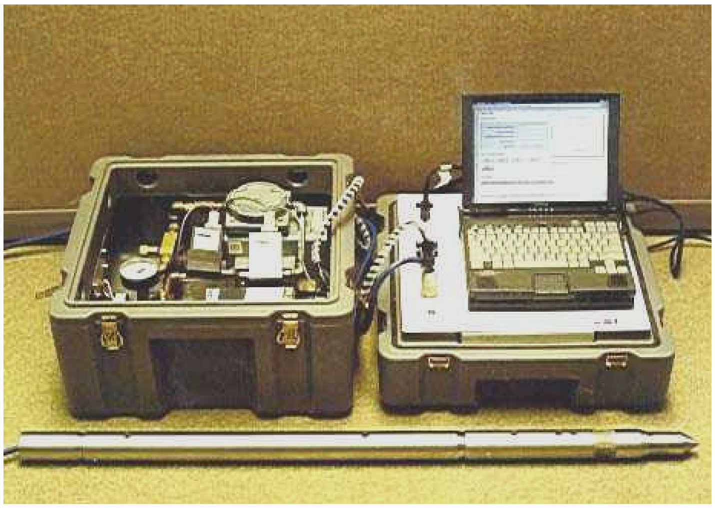
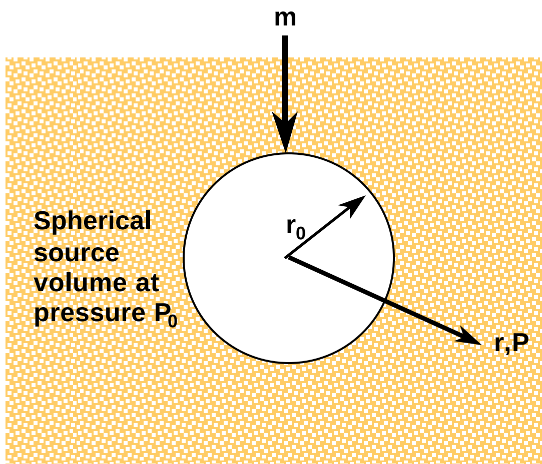


Figure 2. Field system including cone penetrometer rod section and measurement system.

The measurement system uses a methodology based on spherical flow geometry. The basic premise of the approach is that as fluid is injected from a discrete section of the penetrometer rod, it will result in a spherical flow field as the fluid moves outward from the rod. The flow field will become essentially spherical as one moves away from the injection point even if the soil directly adjacent to the rod is compacted. Eventually, for a given injection rate, the radial pressure profile along the axis of the penetrometer rod is identical to that which would occur if the rod (and compacted soil) did not exist. Measurement of the pressure gradient at a distance from the injection point produces adequate information to infer the permeability accurately.

Figure 3 shows the spherical flow geometry and resulting permeability equations. The injection source is represented as a spherical volume with radius (r_o). Fluid is added to the zone at a known rate (m) resulting in a source pressure (P_o). The medium has a permeability (k) that is assumed homogeneous. At a large distance (r_∞) the pore fluid pressure is at ambient conditions (P). Other parameters in the equation are fluid viscosity (μ), gas constant (R), fluid temperature (T), and liquid density (ρ).



Soil Air Flow:

$$k = \frac{\mu R T m}{2\pi\left(P_0^2 - P^2\right)} \cdot \left(\frac{1}{r_0} - \frac{1}{r}\right)$$

Saturated Water Flow:

$$k = \frac{\mu m\left(\frac{1}{r_0} - \frac{1}{r}\right)}{4\pi\rho\left(P - P_0\right)}$$

Figure 3. Conceptual flow field of a Cone Permeameter™ permeability measurement configuration and the corresponding Darcy spherical flow equations for air and water.

The system has been successfully evaluated in two locations at Savannah River Site to assess the performance capability of the technology in various media, both above and below the water table, and to compare Cone Permeameter™ data with existing permeability characterization records of the area.

System Operation

The Cone Permeameter™ rod section is advanced to desired discrete depths and air or water is injected. The permeability of the sediment is a function of the fluid injection rate and the pore pressure gradient in the soil. The pressure data is transmitted to a data acquisition system that converts the pressure response data to measured permeability values. The system allows collection of real-time data that can be used in the field to navigate exploration efforts.

The Cone Permeameter™ can be used to measure soil permeability both above and below the water table. The table below summarizes operating constraints, given that the prototype system design that allowed both measurement of saturated hydraulic conductivity and air permeability in a single tool. If needed, measurement ranges could be expanded by customizing sensor selection for either measurement type.

Table 1. Cone Permeameter™ hydraulic conductivity measurement limits.

Parameter	Maximum	Minimum
Flow (air)	100 lpm	0.2 lpm
Flow (water)	5 lpm	0.2 lpm
Driving pressure (air)	100 psi 689,475 Pa	.0108 psi 75 Pa
Driving pressure (water)	200 psi 1,378,951 Pa	.0108 psi 75 Pa
Permeability (air)	24 Darcies 2.4e-11 m^2	.00001 Darcies 1.6e-17 m^2
Hydraulic Conductivity (water)	100 Darcies 0.096 cm/s	.003 Darcies 2.9e-6 cm/s

The 2" diameter cone penetrometer rod is capable of water or air injection throughout a screened interval. The radial pressure is measured by multiple pressure measurement ports that communicate with sensors embedded in the rod. The injection flow rate is controlled by a fluid pumping system at the surface. Permeability is inferred in real time using the injection flow rates and resulting pressure profiles.

Since the sensor is deployed using cone penetrometer technology, collecting data using the Cone PermeameterTM does not produce any secondary waste and minimizes human exposure to contaminants that could be present in the sediments. The cone penetrometer truck provides an adequate energy supply and the complete electronic cone penetrometer suite. In addition to the persons required to operate the cone penetrometer system, a person is needed to monitor the Cone Permeameter™ as the data are displayed.

SECTION 3
PERFORMANCE

Demonstration Plan

The Cone Permeameter™ has been demonstrated and/or deployed at four waste sites at DOE facilities. The first two locations were at Savannah River Site in South Carolina: the D-Area Coal Pile Runoff Basin and the Old Burial Ground. The third evaluation was performed at Launch Complex 34 at the Cape Canaveral Air Station in Florida and the fourth at the 200 East Area at the Hanford Site.

D-Area Coal Pile

The sediment at the D-Area Coal Pile is composed of interbedded sand, silt, and clay layers. The groundwater and sediment at the site is contaminated with metals leached from the coal piles as well as volatile organic contaminants. A shallow unconfined aquifer system (0 to 15 feet deep) is underlaid by a semi-confined aquifer (50 to 60 feet deep). The confining layer between the two aquifers is characterized as a dark silty clay unit 10 to 15 feet thick. The water table is typically between 4 and 5 feet below ground surface. The location and nature of the confining unit is key to the design and optimization of remedial activities at the site.

Several cone penetrometer pushes at D-Area were successful at making detailed permeability measurements in saturated sediments. Some complications were encountered initially with clay clogging the injection ports, but the problem was remedied by continually injecting a very small volume of water through the ports to flush out the clay. The permeability profile reflected the interbedded nature of the sediment layers logged by the electronic cone penetrometer sensor. As expected, fine-grained layers were found to have lower permeability than coarser-grained layers.

The Cone Permeameter™ results were also compared to pre-existing hydraulic conductivity data taken using a flow meter during a pumping test. The flow meter data give a minimum and maximum value of conductivity at various depths because three different observation wells were used in the pumping tests. Based on the bulk hydraulic conductivity derived at each of these three wells, a range of discrete hydraulic conductivities was determined with the borehole flow meter and the minimum and maximum values are compared with the Cone Permeameter™ data. Figure 4 shows the Cone Permeameter™ values plotted against the high and low values obtained using the borehole flow meter. The permeameter values follow the same trend and are generally between the minimum and maximum conductivity values.

Old Radioactive Waste Burial Ground

Permeability measurements were also collected at the Old Burial Ground at the Savannah River Site. The purpose of this activity was to characterize the nature and uniformity of the permeability distribution in the landfill cover material. The maximum characterization depth was three feet below surface, the thickness of the cover, in order to avoid any contact with contaminated soil.

Permeability measurements were taken at the Old Burial Ground June 29-30, 1998. Successful measurements were made at 10 borehole locations. At three locations the ports became plugged initially, but after cleaning a successful measurement was made at an adjacent location approximately 3 feet away. The data ranged in permeability values from 0.0002 to 1.2 Darcies (2.3e-16 to 1.2e-12 m^2). That degree of variation would be expected in this type of shallow soil with variable moisture content.

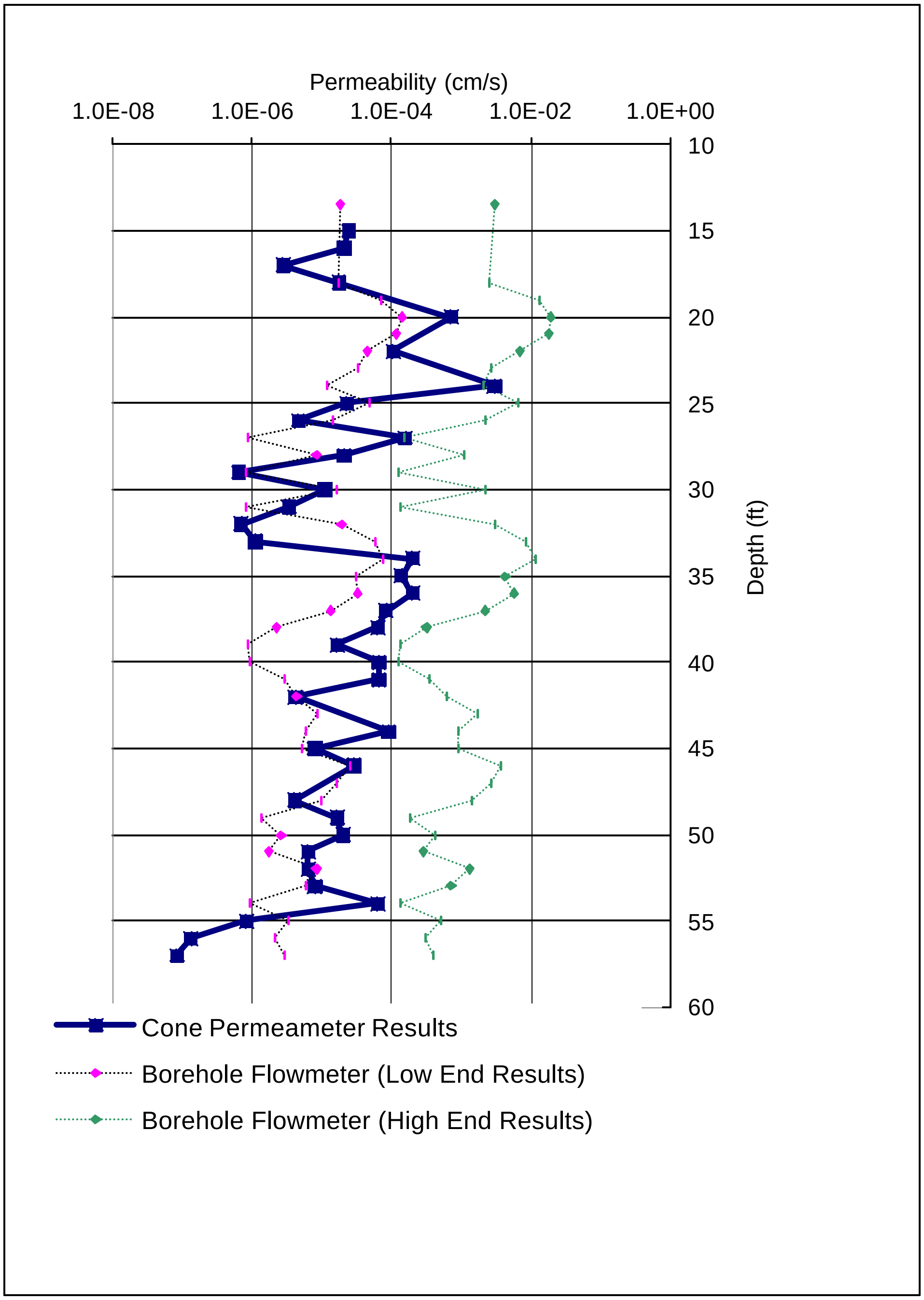


Figure 4. Cone Permeameter™ values (squares) plotted against the high and low values obtained using the borehole flow meter (diamonds).

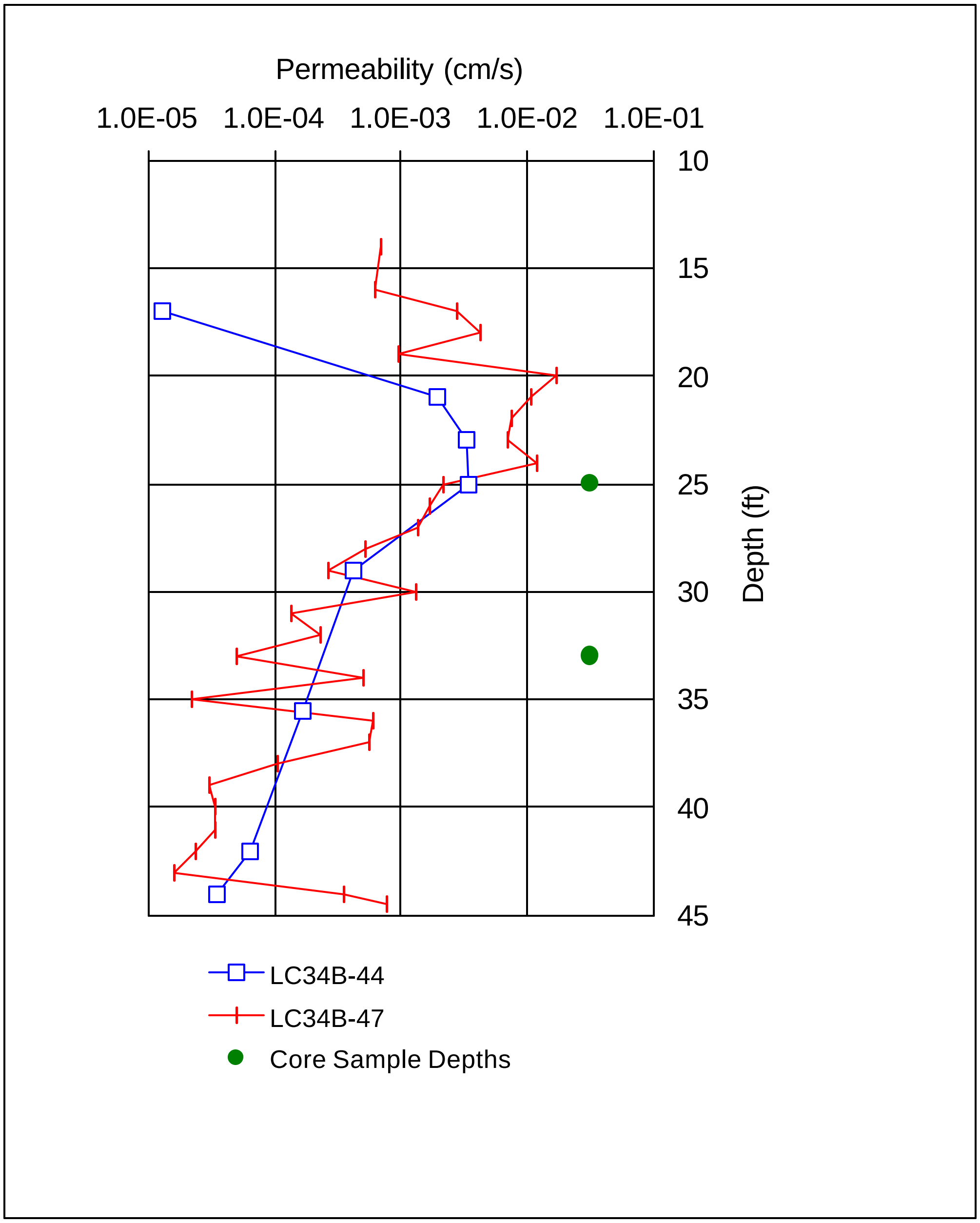


Figure 5. Hydraulic Conductivity Profile of Launch Complex 34 at Locations B44 and B47

Launch Complex 34, Cape Canaveral Air Station, Florida

Launch Complex 34 at the Cape Canaveral Air Station in Florida is the location of the Interagency DNAPL Consortium Site where EPA, DoD, DOE, and NASA are conducting side-by-side evaluations of DNAPL remediation technologies. The shallow, unconfined aquifer underlying Launch Complex 34 (LC34) is characterized by interbedded fine-grained sand and clay with occasional coarse layers of shell fragments. A thin confining unit is found at 45 feet bgs. DNAPL is associated with clayey, fine-grained sands layer distributed throughout the aquifer. The Cone Permeameter™ was used to generate hydraulic conductivity profiles at two locations (LC34B-44, -47). These profiles show the detailed conductivity profile at the site (Figure 5). The most conductive layer seems to be between the depths of 20 and 25 ft below ground surface (bgs). The profile of LC34B-47 indicates interbedding of material, with a 4-5 foot thick fine layer at about 39 feet bgs. The profile from LC34B-44, wth fewer sampling points, does not show the same degree of detail, but the points obtained do follow the same general pattern of the profile from LC34B-47. The locations of two permeability measurements made in the laboratory from core material collected at the site are shown for comparison.

Hanford 200 East Area

In November 1998, the Cone Permeameter™ was used to conduct in-situ air permeability measurements at the 200-East Area at the Hanford Site. The objective of this field effort was to evaluate the ability of the Cone Permeameter™ to accurately measure air permeability of sand, silt, and gravel at a site with a thick unsaturated zone.

Figure 6. Skid-mounted CPT truck at the 200 East Area of the Hanford Site.

Four depth discrete profiles were completed to a maximum depth of 60 feet. Eight to ten minutes were required to make each measurement. The measured permeability values ranged from 0.033 to 8.27 Darcies. Pushes in close proximity to each other resulted in permeability profiles agreeing within one order of magnitude.

Measurements were conducted in a zone where two core samples had been taken for laboratory analysis of saturated hydraulic conductivity. The equivalent saturated hydraulic conductivity obtained by the ConePermeameter™ agreed with the laboratory sample to within half an order of magnitude.

SECTION 4
TECHNOLOGY APPLICABILITY AND ALTERNATIVES

Competing Technologies

[There are two baseline technologies commonly used to measure permeability in the subsurface: either hydraulic testing is done using monitoring wells, or core samples are collected and permeability is measured in the laboratory.

- **Hydraulic testing using monitoring wells.**

– Traditional methods include drawdown tests, slug tests, and pneumatic packer tests.

– These tests are done using single or multiple wells. They are generally more effective if special wells are designed and screened for the test; this significantly raises the cost. Existing wells are often used for testing at sites with many monitoring wells..

– Significant volumes of groundwater, often several hundred or thousand gallons, are produced during pumping tests. In many cases this water must be collected and treated at a significant cost.

– The result of hydraulic testing yields an average permeability measurement for the flow path between the two wells. Measurements can be made with packers to yield a more localized value, but these measurements when made in screened wells will be influenced by the presence of the permeable filter pack outside the well. This is a significantly different type of measurement from the point measurement made using of the Cone Permeameter™. But because the Cone Permeameter™ can make a large number of point measurements at very low cost, the information produced by making a large number of measurements across the test area yields similar results.

- **Laboratory permeameters.**

– Core samples are collected in the field and tested in the laboratory using a permeameter.

– The accuracy of laboratory measurements is limited by the difficulty in obtaining an undisturbed core sample. Sediments can be significantly compacted during drilling operations and sample transport.

The Cone Permeameter™ provides multiple advantages over the baseline alternatives for many study sites. Since the measurement is made with a cone penetrometer and does not require collection of a sample, secondary waste is essentially eliminated. A large number of measurements can be made in a short period of time at a relatively low cost. The ability of the sensor to measure a large number of points results in an accurate and detailed characterization of the subsurface permeability.

Technology Applicability

The Cone Permeameter™ has been demonstrated to be a valuable tool for in-situ measurement of permeability in a variety of applications. The use of the Cone Permeameter™ is especially appropriate at sites where wells suitable for hydraulic testing are not available.

SECTION 5
COST

Introduction

The purpose of this cost analysis is to compare the expense associated with permeability measurements done with the Cone Permeameter™ to those associated with traditional permeability measurement methods such as slug tests and pneumatic packer tests. This cost analysis was prepared for this document by the author and uses actual waste site conditions at SRS to compare a hypothetical site investigation using the baseline method versus the Cone Permeameter™.

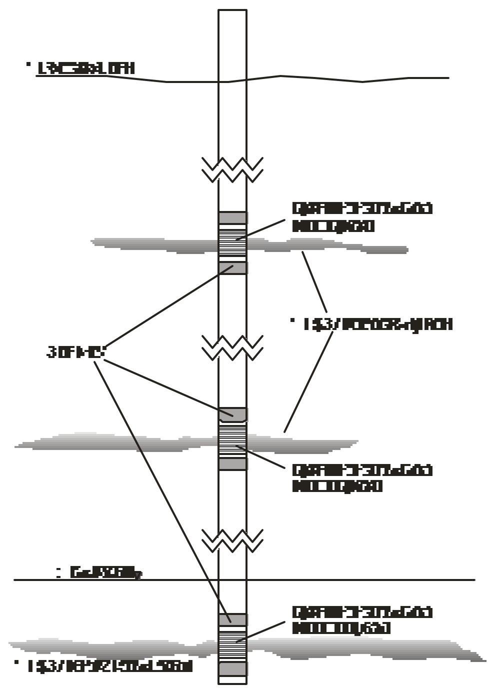


Figure 7. Schematic diagram of actual DNAPL distribution and hypothetical well installed to conduct hydraulic testing at 321-M site at SRS.

The test site for this analysis is the A-M Area at SRS where residual trichloroethylene and tetrachloroethylene are present in the subsurface due to leaks and spills from an above ground solvent storage tank. Previous characterization activities at this site have documented the presence of solvent in subsurface sediments at depths of 40, 99, and 143 feet below ground surface (bgs). The water table in this area is typically 135 feet below ground surface, which means that DNAPL is present in this area in both the vadose and saturated zones. Currently only one monitoring well is present at this site; it is screened from 98 to 103 feet bgs and would not be appropriate for hydraulic testing.

The goal of the hypothetical site characterization is to obtain sufficient permeability data to design a remedial system to efficiently remove the DNAPL contamination at the site. For the purpose of this cost analysis, the following assumptions are made:

- **SEA Cone Permeameter™**

– For this example, cone penetrometer pushes would be made at two separate locations. The measurement interval would be five feet and increased a one-foot interval in the three zones where contamination had been identified flow pathways. Three days are estimated for the collection of the Cone Permeameter™ data.

– Air permeability tests would be conducted in the two shallow zones and water permeability would be measured in the lower zone using the Cone Permeameter. For this analysis, it is assumed that a Cone Permeameter was rented on a weekly basis from a commercial vendor.

– No investigation-derived waste would be produced during cone penetrometer investigations.

– The field results yield permeability values; no additional data reduction is required. In this scenario, one week is allocated for preparation of a report.

- **Baseline Testing**

– Permeability measured using the traditional methods would first require the installation of one monitoring well to perform the pump test. This well would be installed with a hollow-stem auger drill rig. Waste generated during drilling would be contained and disposed of according to site regulations. The well would be installed with three 5-foot long screened intervals that would intersect the zones of DNAPL at the 40, 99, and 143-foot depths.

– Permeability would be measured at each screened interval using a packer to isolate the zone of interest. Air permeability measurements would be made at the two depths screened in the vadose zone, and water permeability would be measured in the saturated zone. The water permeability pumping test would entail the containment and treatment of 1000 gallons of potentially contaminated groundwater. This method would require one week to install the well and perform the permeability tests. Two workers would be required in the field to instrument and operate the pumping test.

– Data reduction analysis of the results from the pumping test would require one week. An additional week is allocated to complete the report.

Cost Analysis

The costs for both scenarios are presented in Tables 2 and 3. The costs are based on 1999 costs for CPT and drilling at the Savannah River Site (MSE Technology Applications, 1999). Estimation of a weekly rental charge for the Cone Permeameter™ was provided by SEA, Inc.

Table 2. Representative costs in 1999 dollars for Cone Penetrometer Investigations at SRS.

Description	Cost, $	Unit	Number of units required	Total Cost, $
CPT	7.25	Per foot	290	2,102.50
Grouting CPT hole	2.50	Per foot	290	725.00
Mobilization and demobilization	1,250.00	Per unit	1	1,250
Per diem for two-person crew	165.00	Per day	3	495.00
Standby labor rate	231.00	Per hour	2	462.00
Rental of Cone Permeameter™	500.00	Per week	1	500.00
Report	180.00	Per hour	40	7,200.00
			Total:	**12,734.50**

Table 3. Representative costs in 1999 dollars for Drilling and Hydraulic testing activities at SRS.

Description	Cost, $	Unit	Number of units required	Total Cost, $
Hollow-stem auger drilling costs	10.00	Per foot	146	1,460.00
Well installation				-
4-inch diameter PVC casing	2.70	Per foot	134	361.80
5-foot PVC screens	3.95	Per foot	15	59.25
Grout	6.25	Per bag	4	25.00
Labor	120.00	Per hour	4	480.00
Mobilization and demobilization	1,000.00	Unit Charge	1	1,000.00
Per diem for three person crew	1,500.00	Per day	2	3,000.00
Decontamination labor rate	175.00	Per hour	1	175.00
Standby labor rate	170.00	Per hour	2	340.00
Drilling waste disposal	2,000.00	Per hole	1	2,000.00
Ground water waste disposal	3.00	Per gallon	1000	3,000.00
Labor in the field for two people	360.00	Per hour	40	14,400.00
Data analysis and report labor	180.00	Per hour	80	14,400.00
			Total:	**40,701.05**

Cost Conclusions

The use of the Cone Permeameter^{TM} under this scenario would result in an approximately 70% cost savings over baseline drilling and hydraulic testing. This should be considered to be a conservative estimate of the cost savings, because this hypothetical example considers drilling only one hole for hydraulic testing. Most typical applications would require instrumenting and monitoring multiple monitoring wells located adjacent to the pumping well. Testing with only one well in multiple zones would yield only one value for bulk conductivity for each of the zones tested. It would not provide details on the vertical or lateral distribution of hydraulic conductivity. Additional wells would be needed to extend the coverage and would result in a relatively large incremental cost if not already installed. Using the Cone Permeameter^{TM} to expand the investigation laterally would result in a relatively small incremental cost (4-8 hours to relocate and push at each additional location) especially when compared to the cost of drilling and installing additional wells. The Cone Permeameter^{TM} could be used to produce a very detailed profile of conductivity at a relatively low cost.**]**

SECTION 6
REGULATORY AND POLICY ISSUES

Regulatory Considerations

Special permits are not required for the operation of a cone penetrometer. The permit process should be less stringent to that required for installation of wells and operation of a pump test since only very small volumes of water are injected.

Risks, Benefits, Environmental and Community Issues

Worker Safety

Occupational Safety and Health Administration (OSHA) requirements should be similar or less stringent than those required by baseline testing.

- The hazards associated with the containment, disposal, and treatment of secondary waste associated with the drilling and installation of wells are significantly reduced or eliminated.

- Crew exposure to hazardous materials is minimized because rods are cleaned before they are drawn into the truck.

- Crew exposure to hazardous materials during the pump testing of the formation (when over a thousand gallons of water must be collected and treated) is eliminated.

- Data are collected in a more rapid manner, thereby reducing the length of worker exposure to hazardous materials.

Community Safety

This technology does not significantly impact community safety.

Environmental Impact

The use of the Cone Permeameter™ should reduce the environmental impact of characterization activities.

- Drill cuttings or secondary waste are virtually eliminated.

- Penetrometer holes are of smaller diameter than conventional well borings and can be sealed during retraction of the rods.

- The penetrometer can be easily decontaminated with only a small volume of fluid.

Socioeconomic Impacts and Community Reaction

The use of the Cone Permeameter™ should not have any socioeconomic impacts. Community reaction should be positive due to the use of an environmentally friendly technology.

SECTION 7
LESSONS LEARNED

Implementation Considerations

The use of the Cone Permeameter™ is limited to sites where a cone penetrometer can effectively penetrate the subsurface. Its use will be restricted where contamination is located deep in the subsurface and in challenging geologic environments. Currently, successes are generally limited to clayey and sandy sediments.

The program manager must work with regulators to assure acceptance of the data collected. The technology should be used to guide and optimize remedial design.

Technology Limitations and Needs for Future Development

The measurement range of the Cone Permeameter™ is currently appropriate for measurements made in both the saturated and unsaturated zone. Work is ongoing to extend the measurement range so that the technology can be applied to air permeability testing in the unsaturated zone.

APPENDIX A
REFERENCES

MSE Technology Applications, 1999, Cost Analysis of Dense Non-Aqueous Phase Liquid Characterization Tools, ECCP-5, MSE Technology Applications, 200 Technology Way, Butte, MT, 59702.
URL address.